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APPARATUS FOR LINING A PIPE

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The present invention relates to a lining apparatus for a pipe having a plurality of constitutive elements which are connected to each other in a line and include as a whole at least one driving means for moving the apparatus in the pipe, a pair of tanks for containing respective paint materials such as main material and hardener, a pair of feeding devices for feeding the respective paint materials, and a paint injecting device for making paint by mixing the paint materials fed by the feeding devices and injecting the paint to the interior surface of the pipe. The paint injecting device has a hollow rotary injector which is rotated by a driving means and has at least one radially elongated portion forming a nozzle at outer end thereof. The radially elongated portion of the rotary injector has a plurality of guide plates inside thereof for mixing the paint materials passing therethrough.

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(56) Documents cited  
GB 1205515  
US 3967584  
US 3895604

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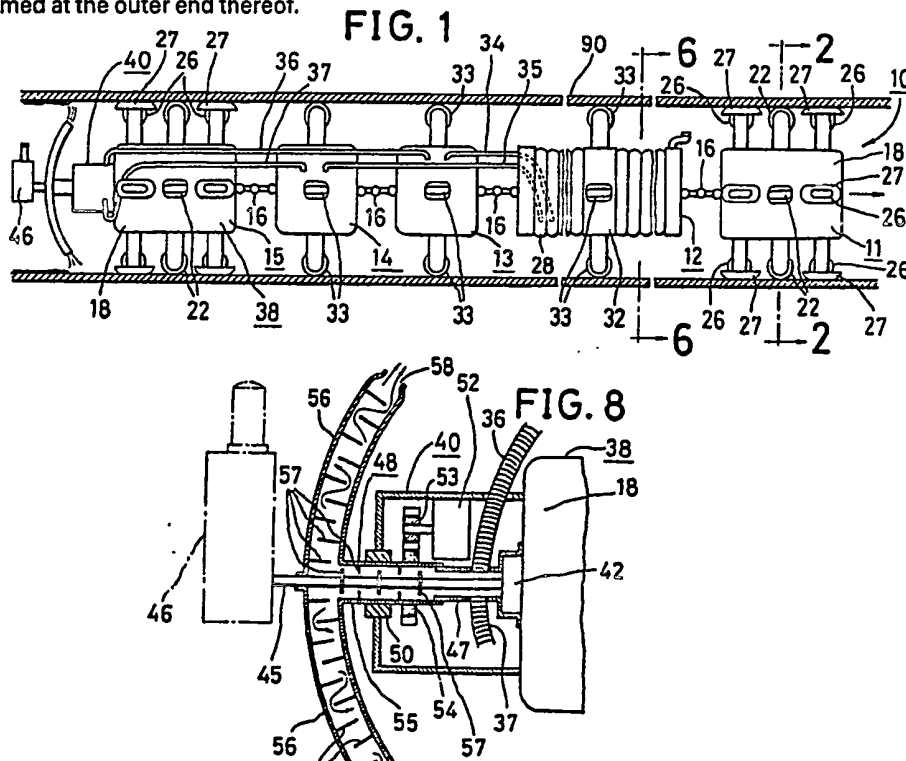
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## (54) Apparatus for lining a pipe

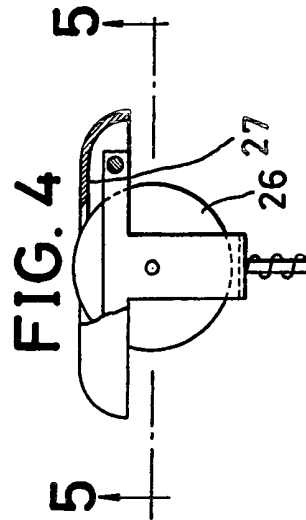
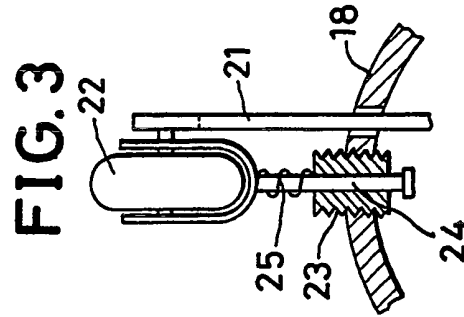
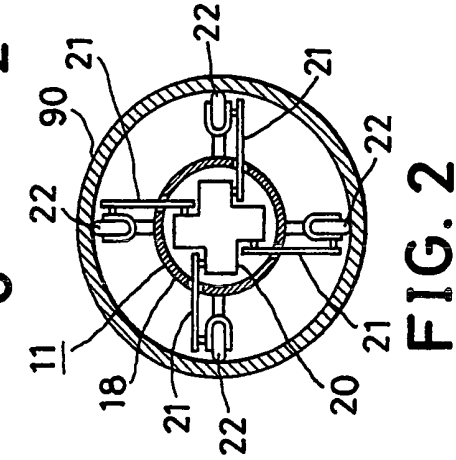
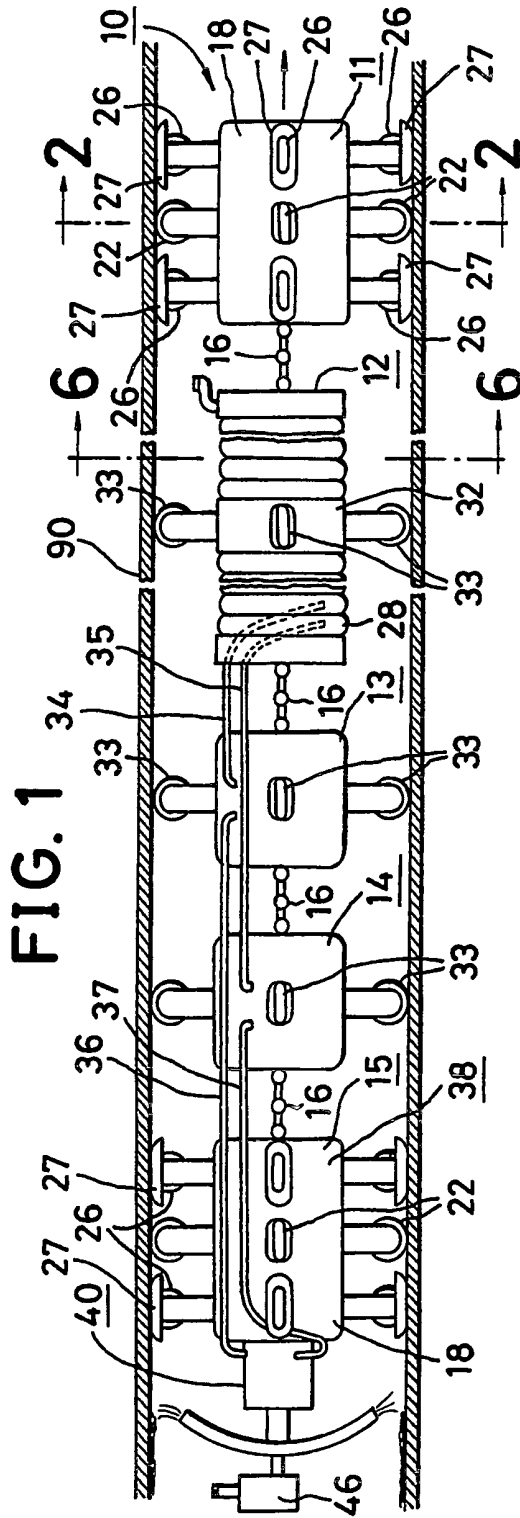
(57) A pipe lining apparatus comprises a plurality of constituent elements 11, 12, 13, 14, 15 pivotally connected to each other in a line, such elements including a driving device 11 for moving the apparatus along a pipe, a pair of tanks 30, 31 for containing respective paint materials in the form of a main material and a hardener, a pair of feeding devices 13, 14 for feeding the respective paint materials, and a paint ejecting device 40 which mixes the main material and the hardener fed by the feeding devices and ejects the paint onto the interior surface of the pipe. The paint ejecting device has a hollow rotary ejector 48 which is rotated by a driving means 52 and has baffles 57 inside it for mixing the paint passing therethrough and radially elongate arms 56 for ejecting the paint from a nozzle 58 formed at the outer end thereof.



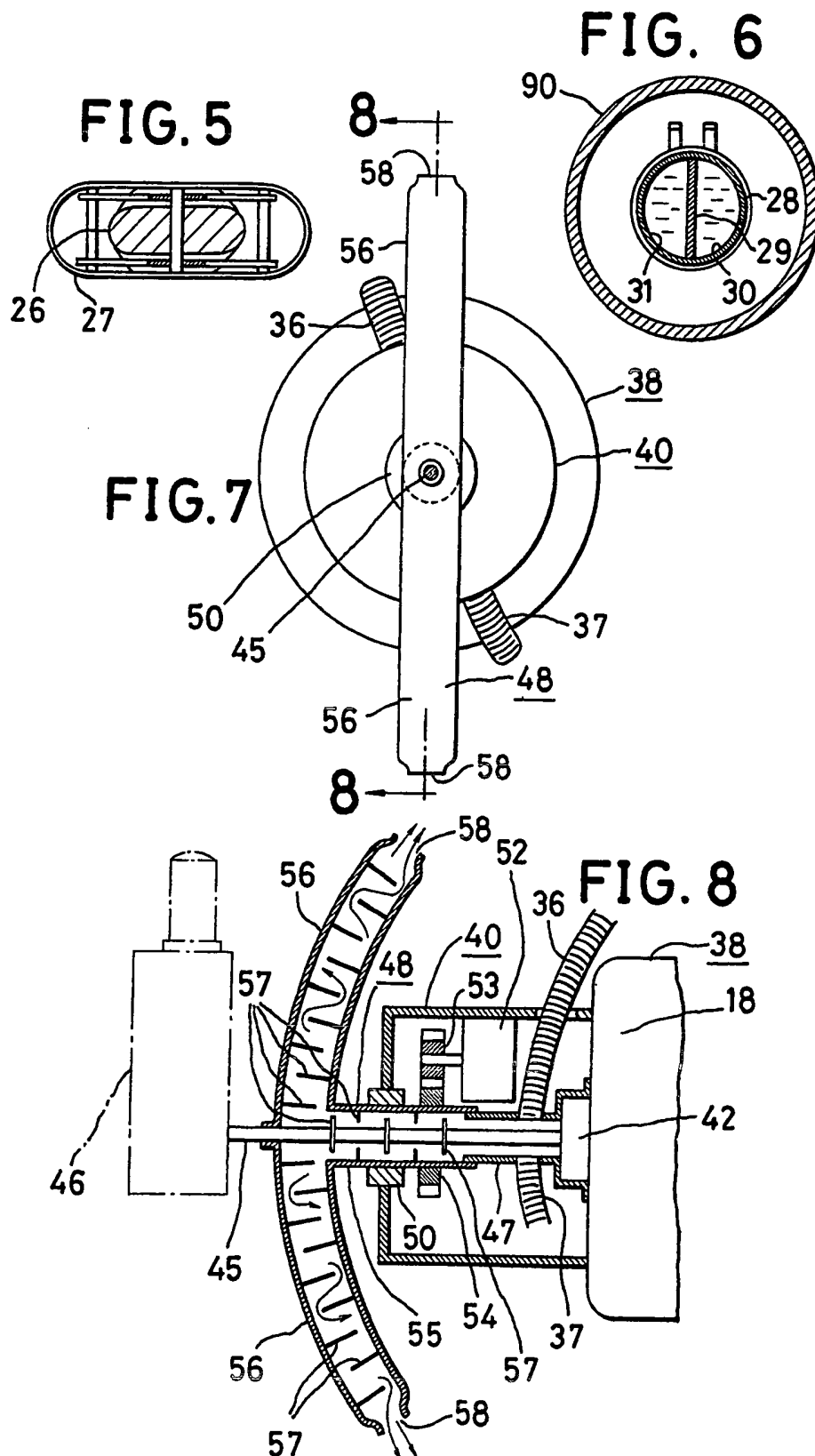
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## SPECIFICATION

## Apparatus for lining a pipe

This invention relates to an apparatus for lining the interior of a pipe, more particularly a pipe of large internal diameter.

A method of lining a pipe is disclosed in U.S. Patent No. 4,327,132, in which epoxy resin paint is supplied by a rapid air stream flowing through the pipe. A pipe lining apparatus is also disclosed in U.S. Patent No. 4,452,169, in which paint is fed by a rotational air flow through the pipe. But, in the case of a pipe having a large interior diameter, a large quantity of paint and a large quantity of compressed air are consumed, and furthermore it is impossible for the paint to effectively and uniformly adhere to the interior surface of the pipe. Therefore, in the case of a pipe having interior diameter larger than 600 mm, for example, a worker enters the pipe and makes the lining by ejecting paint through the nozzle of a paint ejecting apparatus. However, it is still impossible to make a uniform lining in the pipe. Also the worker may suffer an allergic reaction, whereby sometimes his face or hands become swollen. Furthermore, in the automatic lining of a pipe having a large interior diameter, very large hoses are necessary for supplying the constituents of the paint, which have to be maintained at suitable temperature conditions. Thus, an apparatus which is suitable for use in such conditions has not so far been available.

According to the present invention there is provided apparatus for lining a pipe, comprising a plurality of constituent elements pivotally connected to each other in a line, said elements including at least one driving means for moving said apparatus along the pipe, a pair of containers for storing respective paint materials which are to be mixed to make paint, feeding devices for feeding the respective paint materials, and a paint ejecting device including means for mixing the said paint materials fed by said feeding devices and ejecting the paint formed by such mixing onto the interior surface of the pipe.

An embodiment of the invention will now be described by way of example and with reference to the accompanying drawings wherein:—

FIG. 1 is a side view of an embodiment of the present invention, partially cut away, and showing it in use;

FIG. 2 is a sectional view taken along the line 2—2 in FIG. 1;

FIG. 3 is a front view of a driving wheel, partially sectioned;

FIG. 4 is a side view of a guide wheel partially sectioned;

FIG. 5 is a sectional view taken along the line 5—5 in FIG. 4;

FIG. 6 is a sectional view taken along the line 6—6 in FIG. 1;

FIG. 7 is a front view of a paint ejecting device, partially sectioned; and

FIG. 8 is a sectional view taken along the line 8—8 in FIG. 7.

65 shown in FIG. 1, 10 generally designates a lining apparatus. 90 designates a pipe to be lined which has a large interior diameter. The apparatus 10 has five constituent elements 11, 12, 13, 14, 15 which are connected to each other in a line by connecting devices 16 each of which is a universal joint having three or more pivots or a connector having three or more ball-joints.

Referring now to FIGS. 1 to 5, the constituent element 11 is a driving device for moving the lining apparatus 10 along the pipe 90. This device is disposed at one end of the apparatus and it has a casing 18, a prime mover 20 such as an electric motor or an oil pressure motor disposed in the casing 18, and four driving wheels 22 which are driven by the prime mover using belts 21. Each driving wheel 22 is mounted to the casing 18 so as to be adjustable in its position by means of a screw 23 engaged in the casing, a supporting shaft 24 for the wheel extending through the screw and a spring 25 acting to urge the wheel against the interior surface of the pipe 90. The belts 21 are tensioned by a tensioning device (not shown). A plurality of guide wheels 26 are mounted to the casing 18 in a similar manner to the driving wheels 22, but are not driven. A guide member 27 is mounted to the supporting portion of each guide wheel, to prevent tilting of the element 11 at joins in the pipe 90.

Referring now to FIGS. 1 and 6, the constituent element 12 is an elongate tank assembly for containing the materials of the paint. It comprises an outer container member 28 in the form of a bellows made of a soft elastic material, such as rubber or the like, and a partition member 29 made of the same material. The partition member separates the space in the outer container member 28 into a pair of tanks 30, 31 for containing the main paint material and a hardener, respectively. The main material and hardener may be materials for making up epoxy resin paint or other similar paint. 32 designates an annular member which surrounds the outer container member 28 at the central region thereof and is fixed thereto. Four wheels 33 are mounted to the annular member 32 in a similar manner to the driving wheels 22, but are not driven.

The constituent elements 13, 14 are feeding devices having pumps (not shown) which feed the main material and hardener to the tanks 30, 31 by means of hoses 34, 35, 36 and 37. Each of the elements 13, 14 has four wheels 33 each of which is mounted in the same manner as the wheels 33 of the element 12.

Referring now to FIGS. 1, 7 and 8, the constituent element 15 comprises a driving device 38, which is of the same construction as the element 11, and a paint ejecting device 40. The driving device 38 has a casing 18, a prime mover 20 (not shown), driving wheels 22, and guide wheels 26 associated with guide members 27. The paint ejecting device 40 includes an oil pressure motor 42 which is mounted to the casing 18 and has a shaft 45 which rotates slowly. A video camera 46 is attached to the end of the shaft 45. A tubular member 47 is fixed to the casing 18 so as to surround the inner end of the

to the tubular member 47 so as to supply the main material and the hardener for making the paint. A rotary ejector 48 connects to the tubular member 47 and has a tubular portion 55 and a pair of radially elongate arms 56 which are hollow and branched from the tubular portion. The tubular portion 55 is journaled by a bearing 50 and driven at 800 to 1,000 r.p.m. by means of a driving device 52 such as an electric motor or an oil pressure motor fixed to the casing 18, through gears 53, 54. The shaft 45 extends through the rotary ejector 48. A multiplicity of baffle plates 57 are provided in the tubular portion 55 and on the shaft 45 so as to project alternately therefrom, and are also mounted to the radially elongate arms 56 so as to project alternately from the front walls and the back walls thereof, whereby the passages through the rotary ejector 48 are suitably tortuous for mixing the paint. The baffles disposed in the arms 56 may be formed so as to project from the left and right sides thereof rather than from the front and back sides. Nozzles 58 are formed at the outer ends of the arms 56.

The apparatus 10 has a storage battery (not shown) as its source of electric power and an oil pump driven by an electric motor provides the pressure oil source. Electric power may alternatively be supplied from an external source.

When the apparatus is moved in the direction of the arrow in FIG. 1 by the prime movers 20 of the elements 11 and 15, and at the same time the pumps of the elements 13, 14 are driven and the rotary ejector 48 is driven, paint which has been well mixed by passing through the rotary ejector 48 is ejected on to the interior surface of the pipe 90 from the nozzles 58 and adheres uniformly thereto, thus lining the interior surface of the pipe. The condition of the lining can be watched remotely by means of the video camera 46. Control of the lining apparatus may be by radio signal. The apparatus can move along a pipe 90 which is curved in any direction, the centers of the elements 11, 12, 13, 14, 15 passing along the center of the curved portion of the pipe without any trouble whilst a lining is being applied. In a case where the element 12 is particularly long, it can itself curve along the interior surface of a curved portion of the pipe.

It is possible to make various changes in the above described embodiment. For example the main material and the hardener of the paint may be contained in different constituent elements of the apparatus. In such cases, the elements concerned

may be of rigid construction, without flexibility. The element 15 may comprise only the paint ejecting device 40, without a driving device 38. If the apparatus is to be used only for horizontal pipes, each element may have wheels for supporting it only from underneath. The rotary ejector 48 may have three or more radially elongate arms 56, or only one such arm.

It is to be clearly understood that there are no particular features of the foregoing specification, or of any claims appended hereto, which are at present regarded as being essential to the performance of the present invention, and that any one or more of such features or combinations thereof may therefore be included in, added to, omitted from or deleted from any of such claims if and when amended during the prosecution of this application or in the filing or prosecution of any divisional application based thereon.

#### CLAIMS

1. Apparatus for lining a pipe, comprising a plurality of constituent elements pivotally connected to each other in a line, said elements including at least one driving means for moving said apparatus along the pipe, a pair of containers for storing respective paint materials which are to be mixed to make paint, feeding devices for feeding the respective paint materials, and a paint ejecting device including means for mixing the said paint materials fed by said feeding devices and ejecting the paint formed by such mixing onto the interior surface of the pipe.

2. Apparatus as claimed in claim 1, wherein said paint ejecting device includes a hollow rotary ejector which is rotatable by driving means and has internal baffles for mixing the paint passing therethrough and at least one radially elongate arm arranged to eject the paint from a nozzle formed at the outer end thereof.

3. Apparatus as claimed in claim 2, wherein said paint ejecting device has a plurality of said radially elongate arms.

4. Apparatus as claimed in any of claims 1 to 3, wherein each of said constituent elements has a plurality of positionally adjustable wheels arranged to contact the interior surface of a pipe and to center the said elements therein.

5. Apparatus for lining a pipe, substantially as hereinbefore described with reference to the accompanying drawings.